

**REMARKS**

This application relates to a process for manufacturing a carbon fiber.

Claims 1 - 15 and 17 - 29 are pending, with claims 20 - 29 being withdrawn, and claims 1 - 15 and 17 - 19 being rejected. Claims 1 - 4, 6, 8 - 14 and 17 - 19 were rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by U.S. Patent No. 3,639,953 ("Kimura") and optionally further in view of JP 2001-073226 ("Masaru") as evidence of inherency. Claims 1 - 4, 6, 8 - 14 and 17 - 19 were rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Kimura in view of Masaru. Claims 7 and 15 were rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Kimura and optionally further in view of Masaru. Claim 5 was rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Kimura and optionally further in view of Masaru as applied to claims 7 and 15 above, and further in view of Lewis (U.S. Patent No. 3,995,014) ("Lewis"). Claims 8 - 11 were rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Kimura and optionally further in view of Masaru as applied to claims 7 and 15 above, and further in view of U.S. Patent No. 3,852,428 ("Powell"). Claims 1 - 4, 6 - 15 and 17 - 19 were rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Masaru in view of Kimura. Claim 5 was rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Masaru in view of Kimura as applied to claims 1 - 4, 6 - 15 and 17 - 19 above, and further in view of Lewis.

Claims 1 - 4, 6, 9 - 11 and 14 were provisionally rejected on the ground of non-statutory obviousness-type double patenting as allegedly being unpatentable over claim 45 of copending Application No. 10/578,776. Claim 15 was provisionally rejected on the ground of non-statutory obviousness-type double patenting as allegedly being unpatentable over claim 39 of copending Application No. 10/578,776. Claim 5 was provisionally rejected on the ground of non-statutory

obviousness-type double patenting as allegedly being unpatentable over claim 42 of copending Application No. 10/578,776. Claims 7, 12, 13 and 17 - 19 were provisionally rejected on the ground of non-statutory obviousness-type double patenting as being unpatentable over claim 37 of copending Application No. 10/578,776 in view of Kimura and optionally further in view of Masaru.

To facilitate the Examiner's review, claim 1 is reproduced below.

1. A process for manufacturing a carbon fiber, comprising the steps of:
  - (1) spinning or forming a mixture of 100 parts by weight of a thermoplastic resin and 1 to 150 parts by weight of at least one thermoplastic carbon precursor selected from the group consisting of pitch, polycarbodiimide, polyimide, polybenzazole and aramide into a precursor fiber or a precursor film;
  - (2) subjecting the precursor fiber or film to a stabilization treatment by contacting to gas containing oxygen and/or halogen gas to stabilize the thermoplastic carbon precursor contained in the precursor fiber or film so as to form a stabilized precursor fiber or film;
  - (3) removing the thermoplastic resin from the stabilized precursor fiber or film to form a fibrous carbon precursor; and
  - (4) carbonizing or graphitizing the fibrous carbon precursor to form a carbon fiber.

**Response to Rejection of Claims 1-4, 6, 8-14, and 17-19 Under 35 U.S.C. § 102(b)**

Applicant respectfully traverses for at least the following reasons.

**Kimura (U.S. Patent 3,639,953)**

**Spinning Method**

In Kimura, fibers are formed by spinning concurrently a pitch and a synthetic organic polymer melted separately through a common nozzle. See col. 1, lines 39-48 of Kimura. In Kimura's method, fibers are formed by combining two separate polymer streams just before their delivery to the spinning nozzle. The fiber made from a method such as Kimura's is called a

**bicomponent fiber** (conjugated fiber). A side-by-side type conjugated fiber and a sheath-core type conjugated fiber are exemplified in Kimura as typical bicomponent fibers.

In contrast to this, fibers are formed by mixing two polymers before delivery to the spinning nozzle in the present invention. See, e.g., page 21, line 31 through page 22, line 7 of the present specification. Particularly, a mixture of a thermoplastic resin and a carbon precursor is spun as recited in claim 1. The type of fiber made from this method is called a **polymer blend fiber**.

The differences between the type of fiber produced by the presently claimed process and the type of fiber formed by the method of Kimura can be further understood from the attached excerpts from "Structure Formation in Polymeric Fibers" and "High Technology Fibers". Referring to page 2 of the excerpt from "High Technology Fibers," the difference between "polyblend" fibers and "bicomponent" fibers is seen to be a basic understanding common among those skilled in the art. Referring to page 403 of the excerpt from "Structure Formation in Polymeric Fibers", bicomponent fibers such as a side-by-side fiber and a sheath-core fiber are described in Fig. 11.1(a). In contrast, a polymer blend fiber is described in Fig. 11.1(b).

Accordingly, in the present application, the spinning process and the structure of fiber produced by the spinning is completely different from the method and fibers of Kimura. Therefore, Kimura clearly does **not** anticipate the present invention.

#### Diameter

According to the present invention, the carbon precursor in the mixture forms an "island phase" having a diameter of 0.01 to 50  $\mu\text{m}$  (page 14, lines 1-27 of the specification). The thermoplastic resin surrounds the carbon precursor and forms a "sea phase". Please see Fig. 1 of the present application. Therefore, the diameter of the carbon precursor is very small.

In contrast, in Examples 1 and 2 of Kimura, a sheath-core type conjugated fiber is spun through nozzles having a diameter of 0.2 mm (200  $\mu\text{m}$ ). Petroleum asphalt is used as a sheath (outside). See col. 5, line 75 through col. 6, line 1 of Kimura. Therefore, the diameter of Kimura's carbon precursor is about 200  $\mu\text{m}$ , which is much larger than the present invention. See col. 6, lines 50-51 of Kimura.

In Example 3 of Kimura, a side-by-side type conjugated fiber is spun with the ratio of petroleum asphalt/polyethylene of 2/1 through nozzles having a diameter of 0.2 mm (200  $\mu\text{m}$ ). It appears that the carbon precursor occupies 2/3 of cross sectional area of the formed side-by-side type conjugated fiber. Therefore, the diameter of the carbon precursor is almost 200  $\mu\text{m}$  which is much larger than the present invention.

The diameter of bicomponent fiber (conjugated fiber) is determined by the nozzle size. According to the method of Kimura, it is difficult to spin a fiber having very small diameter, such as for the present invention, since there is a limit to the minimum diameter of the nozzle. However, it is possible in the present invention to spin a carbon fiber having very small diameter by forming an "island phase" of carbon precursor in polymer mixture.

**Masaru (JP 2001-073226)**

Masaru indicates that polyethylene of a sea component is removed by pyrolysis. See paragraph [0021] of Masaru.

However, Masaru cures a phenol resin by aldehyde under the existence of a crosslinking catalyst using a solution of 5 to 20% weight of formaldehyde. See paragraphs [0018] and [0019] of Masaru. The presently claimed invention specifies that the stabilization treatment is performed "by contacting to gas containing oxygen and/or halogen gas." See claim 1.

Masaru uses a wet process. In contrast, the present process uses a vapor phase process. Masaru differs from the present invention by using aldehyde and a crosslinking catalyst. Applicant submits that the method disclosed in Masaru has the drawback that the phenol resin must be stabilized by a wet process for a long time and is hardly aligned and hardly graphitized, with the result that the development of strength and elastic modulus from the fine carbon fiber obtained cannot be expected. See page 2, lines 26-34 of the specification.

In view of the above, Applicant respectfully submits that claims 1 - 4, 6, 8 - 14, and 17 - 19 are not anticipated by Kimura, even further in view of Masaru as alleged evidence of inherency.

Reconsideration and withdrawal of the anticipation rejection based on Kimura, even further in view of Masaru, is respectfully requested.

Below, Applicant addresses the several rejections under 35 U.S.C. § 103, all of which rely on Kimura or Masaru as a primary reference.

**Response to Obviousness Rejections of Claims 1-4, 6-15, and 17-19 Based on Kimura in View of Masaru, Kimura optionally further in view of Masuru, and Masaru in view of Kimura**

Applicant respectfully traverses.

Kimura has deficiencies as discussed above with respect to the anticipation rejection. Masaru has the deficiencies as discussed above with respect to the anticipation rejection. Neither Kimura nor Masaru appear to make up for the deficiencies in the other reference.

Therefore Applicant respectfully submits that the presently claimed invention is not rendered obvious by any combination of Masaru and Kimura.

Reconsideration and withdrawal of the obviousness rejections based on combinations of Kimura and Masaru are respectfully requested.

**Response to Rejections of Claim 5 Under 35 U.S.C. § 103(a) Based on Kimura in view of Masaru and Further in View of Lewis, as well as Masaru in view of Kimura further in view of Lewis**

Applicant respectfully traverses.

Applicant respectfully submits that claim 5 is not rendered obvious by the proposed combinations of Kimura, Masaru, and Lewis, because Lewis discloses only the use of mesophase pitch. See Abstract of Lewis. Moreover, Applicant respectfully submits that, as discussed above, Kimura and Masaru are deficient with respect to claim 1 and Lewis does not appear to make up for the deficiencies of Kimura and Masaru. Moreover, Masaru and Kimura do not appear to make up for the deficiencies of Lewis.

In view of the above, Applicant respectfully submits that claim 5 is not rendered obvious by any combination of Kimura, Masaru, and Lewis.

**Response to Rejection of Claims 8-11 Under 35 U.S.C. § 103(a) Based on Kimura in view of Masaru in view of Powell**

Applicant respectfully traverses.

Applicant respectfully submits that claim 8 and claims 9-11 dependent thereon are not rendered obvious by Kimura, optionally in view of Masaru, further in view of Powell.

In claim 8 of the present application, a specific polymer is used in addition to the organic material as a compatibilizing agent. Powell is characterized in using a small amount of polymer. 5 wt% of polypropylene is used, based on the weight of a coal extract in Example 1. See col. 4, lines 24 - 32 of Powell.

Therefore, the amount of material other than the carbon precursor is completely different from the present invention, as summarized in the table below.

	the present invention	Powell	
	Claim 8	Claim 1	Example 1
Organic material	100 pbw	0.05-30 pbw	5 pbw of polypropylene
Carbon precursor	1-150 pbw	70-99.5 pbw	95 pbw of a coal extract
polymer (compatibilizing agent)	0.001-20 pbw	<u>none</u>	<u>none</u>

In view of the above, Powell does not appear to make up for the deficiencies of Masaru and Kimura.

In view of the above, Applicant respectfully submits that claim 8 and claims 9-11 dependent thereon are not rendered obvious by the proposed combination of Kimura in view of Masaru in view of Powell.

**Response to Non-statutory Double Patenting Rejection Based on Application No. 10/578,776**

In response, Applicant files herewith a Terminal Disclaimer to obviate this provisional rejection.

Withdrawal of this provisional rejection is earnestly solicited.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is

RESPONSE UNDER 37 C.F.R. § 1.116  
Application No.: 10/529,758

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kindly requested to contact the undersigned Attorney at the local Washington, D.C. telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,


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**23373**

CUSTOMER NUMBER

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